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ABSTRACT

Proposed is a comprehensive instructional design model which (1) suggests a systems-based approach to preparing, implementing, and evaluating instruction at the program syllabus, course syllabus, and instructional unit levels; (2) subsumes those various dimensions of a mastery learning strategy which encompass preconditions, operating procedures, and anticipated consequence; (3) relates the generic activities of instructional design to those essential elements comprising a mastery learning strategy; (4) provides a broad-based context for interpreting completed and on-going research and development efforts in mastery learning; and (5) represents a multidimensional framework for guiding future basic and applied research as well as the subsequent development efforts in mastery learning. Areas of congruence between generic activities in instructional design and essential components in a mastery learning strategy, as well as additional activities mandated by any comprehensive instructional design effort, have provided the basis for identifying possible variables of an independent, moderator, dependent, and intervening nature which might be considered in future mastery learning research and development endeavors. (Author/PN)

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AN INSTRUCTIONAL DESIGN MODEL FOR GUIDING MASTERY LEARNING RESEARCH AND DEVELOPMENT EFFORTS

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AN INSTRUCTIONAL DESIGN MODEL FOR GUIDING MASTERY LEARNING RESEARCH AND DEVELOPMENT EFFORTS

The intent of this paper is to propose a comprehensive model for designing instruction which can serve as a basic guide for directing mastery learning research and development efforts. The comprehensive instructional design model (Hymel, in press) suggests a systems-based approach to preparing, implementing, and evaluating instruction at the program syllabus, course syllabus, and instructional unit levels. Given the varied dimensions of a mastery learning strategy which emphasize preconditions, operating procedures, and anticipated consequences (see Block, 1971; Block & Anderson, 1975; Bloom, 1968), it follows rather logically that a relationship might be demonstrated between (a) the generic activities embedded in a systematic approach to designing instruction and (b) the essential elements comprising a mastery learning strategy. Such a relationship, in turn, would provide a conceptual framework within which past mastery learning research might be critiqued and future research might be planned.

Mastery Learning Considerations

By way of a brief review, mastery learning is a topic in the field of instructional psychology which has implications regarding the systematic preparation, implementation, and evaluation of instruction. More specifically, mastery learning is an approach to individualizing instruction which (a) emphasizes diagnostic-prescriptive teaching and (b) assumes that the majority of students in a course can indeed learn the contents of the course to a high degree of competency provided that the quality of instruction is optimal.

In their 1976 state-of-the-art review of the mastery learning literature, Block and Burns organized the available research literature into the following four categories:

Type I mastery learning research (MLR) represents the earliest kind and focuses on the question "Does it work?"

Type II MLR represents a logical sequel to the aforementioned in that it begins to look beyond the immediate cognitive effects of mastery learning strategies on students and to focus on the question "If it works, then what might follow?" The expanded focus here is on such areas as affective consequences; time considerations; learning-to-learn effects; and teacher-role, administrative, curricular, sociological, and economic implications.

Type III MLR addresses the following two kinds of studies and related research questions: (a) student-entry characteristic studies which focus on the question "Do mastery strategies have the same effects on different kinds of students, i.e., students with different kinds of cognitive and affective entry characteristics?" and (b) component studies which ask "Do some components of mastery strategies have greater effects on students than other components?"

Type IV MLR attempts to translate findings about why mastery strategies work into statements of how they can be implemented and, hence, focuses on the question "How does it work?"

It is in the realm of the Type III MLR that the greatest potential lies for mastery learning researchers and practitioners who are interested in advancing basic and applied inquiries as well as the development work which would follow. The so-called student-entry characteristic studies are essentially an aptitude-treatment interaction (ATI) concern. The other dimension of Type III MLR--component-related

studies--encompass such diverse and "research fertile" areas as study questions, instructional objectives, advance organizers, learning unit size, unit pacing, unit social organization, unit feedback instruments, unit mastery requirements, unit correctives, and course grading policy. In a somewhat more succinct form, Block and Anderson (1975) have identified the major components of a mastery learning strategy as follows: relatively small, manageable units of instruction that are sequentially arranged; the specification of performance objectives and expected levels of proficiency; criterion-referenced formative and summative tests; and learning correctives.

What is needed at this stage in the history of mastery learning is a comprehensive instructional design model that would function as a "grand mosaic" subsuming the numerous aspects of completed, on-going, and future mastery learning research and development efforts--particularly those of the Type III genre. The discussion which follows proposes such a model.

Instructional Design Considerations

The process of instructional design involves specifying and producing particular environmental situations in the classroom which incline students to react in such a way that a specified change occurs in their behavior (Merrill, 1971). More specifically, the task of designing instruction can be viewed as encompassing three major activities: preparing instruction, implementing instruction, and evaluating instruction. A basic premise in this paper is that the major activities comprising instructional design are most effectively accommodated when (a) a systems-based format is employed and

(b) they are addressed at the three levels of instructional design: the program syllabus, course syllabus, and instructional unit levels.

An Overview of a Systems-Based Model for Designing Instruction

The relationship between the phases (i.e., activities) and levels of instructional design is such that the tasks of preparing, implementing, and evaluating instruction represent (a) the means to generating instructional products or documents labelled program syllabus, course syllabus, and instructional unit and (b) the activities that are actually engaged in by the teacher in the attempt to interact with students at three levels in the instructional process. Figure 1 is a relatively simple illustration of the predominantly deductive movement in the overall process of designing instruction at the program syllabus level (e.g., a four-year mathematics program in a high school), course syllabus level (e.g., an Algebra I course within the mathematics program), and instructional unit level (e.g., an Algebra I unit on solving quadratic equations).

Insert Figure 1 about here

Designing Instruction at the Program Syllabus and Course Syllabus Levels

Figure 2 illustrates a systems-based model for designing a program syllabus. Figure 3 represents a checklist for designing a program syllabus which is intended to accompany the model. The flowchart and its accompanying checklist are intended to serve as a schematic illustration and quasi-narrative, respectively, depicting the 11 components which comprise a program syllabus and, hence, need to be developed as one form of documenting the preparatory,

implementation, and evaluative activities that have been designed for the particular instructional program being addressed.

Insert Figure 2 about here

Insert Figure 3 about here

Figures 4 and 5 represent a systems-based model and accompanying checklist, respectively, for designing a course syllabus. As was the case with the program syllabus, the course-oriented flowchart and checklist depict the 12 components which comprise a course syllabus designed from a systems-based perspective and, hence, represent the type of documentation appropriate to this level of instructional design.

Insert Figure 4 about here

Insert Figure 5 about here

Designing Instruction at the Instructional Unit Level

The instructional unit represents the most specific level at which instruction is designed. Accordingly, Figures 6 and 7 represent a systems-based model and checklist, respectively, for preparing, implementing, and evaluating an instructional unit.

Insert Figure 6 about here

Insert Figure 7 about here

Given the high degree of specificity called for at the instructional unit level, it is perhaps best to consider the components of a unit in the context of the three phases of the design effort.

Phase I: Preparing instruction. The unit description and rationale components are aspects of preparing an instructional unit and should reflect the unit goal specified earlier in the course syllabus. (It is presumed here that the delineation of course goals in the course syllabus reflects in large measure the goals of those units comprising the course.) With respect to the unit rationale, an attempt is made to justify for the student the inclusion of the unit in the course by an appeal to (a) its unique value as a dimension of the course, (b) its relationship to previous topics as a continuation of or sequel to that which has already been covered in the course, and (c) its relationship to future topics as, perhaps, a prerequisite or foundation to material yet to be addressed.

The performance objectives component is likewise an aspect of preparing instruction at the unit level. As elaborated on extensively in the professional literature (e.g., Baker & Popham, 1973; Kibler, Cegala, Barker, & Miles, 1974; Mager, 1962), this component specifies in a detailed fashion the precise behavior (learning) for which the student will be held accountable subsequent to instruction, including an indication of the conditions under which the behavior is to be demonstrated and the proficiency level to be attained. This component should serve to provide a basis for (a) communication among students,

educators, and parents as to instructional expectations, (b) planning on the part of teacher and student, and (c) evaluation of student performance and instructor effectiveness. Furthermore, if the statement of performance objectives is delineated in terms of terminal and enabling objectives, then a mechanism is available for identifying the order in which the various learning tasks are to be mastered.

Another component of the unit related to the preparation of instruction involves the identification and/or assessment of prerequisite competencies. Since the progression in learning is from the known to the unknown, it is important that a determination be made of the exact prerequisite competencies required of, and hopefully possessed by, the student upon entry into the unit. Otherwise, the appropriate starting point in the presentation of a new topic would not be known by the teacher. Whether the prerequisite competencies appropriate to a unit are simply identified by the teacher for the benefit of students or actually assessed by the teacher is partially a function of the nature of the material to be covered. The former would probably suffice if the material is not highly sequential and hierarchical; otherwise, both the identification and assessment of prerequisite competencies might be in order.

A final component related to the preparation of instruction involves the delineation and sequencing of the topics comprising the unit via an advance organizer. As discussed by Ausubel (1963), an advance organizer is a written aid made available to a student for the purpose of helping him relate the potentially meaningful material to be learned to the cognitive base (structure) which he

already possesses. It provides the student with a subsumer which gives him a general overview of the more detailed material prior to his actual encounter with it. Although the typical format used with advance organizers is that of a written narrative which makes use of the student's established knowledge to increase the familiarity and learnability of the new material, other formats such as a topical outline, schematic illustration, flowchart, film, or audiotape may be employed.

Phase II: Implementing instruction. Quite obviously, the instructional methods selected and used by the teacher in a unit as well as the student activities assigned for completion in and out of class are features of implementing instruction. Of particular note here is the necessity for the instructional methods and student activities to reflect the performance objectives addressed in the unit. The logic behind this assertion is based on Gagné's (1977) contention that performance objectives serve as indicators of the type of learning being addressed, which in turn serve as determiners of the most appropriate instructional methods and learning activities. For example, the conditions of teaching and learning which should surround a conceptual learning task are different from the conditions associated with problem solving as a type of learning and, hence, should be recognized and accommodated by the instructor.

Instructional resources represent another facet of implementing instruction. The teacher has three realms from which to select: (a) commercially-prepared resources, (b) instructor-prepared resources, and (c) resource personnel. In the case of the first two, whether one is selecting commercial resources or developing teacher-made

materials, it is important that instructional design criteria be used in the selection or development process. The components of a systems-based instructional unit that are presently being addressed would suffice as guidelines for directing the selection/development effort. With respect to the utilization of resource personnel, one should be sensitive to possible discrepancies between the students' perceptions of credible models or significant others and the actual background of the person used as a resource.

Phase III: Evaluating instruction. As indicated in the systems-based model for designing an instructional unit, formative evaluation and learning correctives represent two important components. Although these two components are crucial sequels to the initial delivery of instruction on unit topics, and perhaps could be justified as aspects of implementing instruction, they are cited here as components of the evaluation phase which have a pronounced instructional value.

Formative evaluation (variously known in the present context as criterion-referenced trial testing, practice testing, or diagnostic testing) provides on-going, intermittent feedback to the teacher and student concerning the latter's progress at various stages in a given unit of instruction. This form of criterion-referenced testing occurs several times prior to the completion of the unit and makes possible the identification of learning deficiencies and the subsequent prescription of alternative remedial measures. Formative evaluation, then, provides the "diagnostic" part of any attempt at diagnostic-prescriptive teaching.

As the flowchart indicates, the results of the formative testing suggest how effective or ineffective were the sequencing of topics

via the advance organizer, the instructional methods, the student activities, and the resources used at various stages in the unit. In those instances when the formative test results indicate a learning deficiency on the part of a student, then learning correctives may be prescribed. These may include alternative ways of sequencing the material, delivering instruction, involving students via assignments, and employing resources. The learning correctives, then, represent the "prescriptive" part of any attempt at diagnostic-prescriptive teaching.

The summative evaluation component in this model refers to a criterion-referenced assessment at the end of the unit to determine a student's letter grade as based on demonstrated mastery of the unit's prespecified performance objectives. Finally, the unit evaluation component refers to (a) the students' opportunity to assess the instructional quality of the unit (perhaps via a brief questionnaire) and (b) the type of achievement distribution attained on the summative test (a negatively skewed curve suggesting instructional success).

Relating Mastery Learning to Instructional Design

Mastery Learning Subsumed Under Instructional Design

The general overview of systems-based instructional design (Figure 1) as well as the more detailed schematics at the program syllabus, course syllabus, and instructional unit levels (i.e., Figures 2, 4, and 6, respectively) represent conceptual models which subsume the essential elements of mastery learning discussed earlier.

Perhaps the most functional level at which mastery learning relates to instructional design is at the instructional unit level. It is at

this level that one encounters the greatest degree of instructional design specificity regarding preparation, implementation, and evaluation activities that bring the instructor into direct contact with the students. More directly, it is at the instructional unit level that the following crucial design components are addressed: identifying and justifying topical coverage; specifying performance objectives and the appropriate levels of proficiency; identifying and/or assessing prerequisite competencies; sequencing content in a logical and hierarchical fashion; selecting instructional methods, student assignments, and resources reflective of the type of learning addressed; providing for diagnostic-prescriptive teaching via the use of formative tests and learning correctives; and evaluating in a summative fashion. Likewise, it is at this level that the instructor interacts with the students in addressing such mastery strategy components (see Block & Anderson, 1975) as (a) the sequential positioning of the instructional unit, (b) the specification of performance objectives and expected levels of proficiency, (c) the hierarchical sequencing of subject matter within the unit, (d) instructional delivery via a group-based or individual-based format, (e) formative testing, (f) prescription of learning correctives, and (g) summative testing.

Mastery Learning Research and Development Directions Suggested by Instructional Design

The subsumption of mastery learning components under the encompassing mosaic of instructional design serves to suggest (a) a broad-based context for interpreting completed and on-going research and development efforts in mastery learning and (b) a multidimensional framework

for guiding future basic and applied inquiries as well as the subsequent development work in mastery learning.

With respect to possible independent and moderator variables emanating from the comprehensive instructional design model, the following would be pertinent to mastery learning: (a) sequential positioning and justification of courses within a program, units within a course, and subject matter within a unit; (b) specifying performance objectives, appropriate to different types of learning, within the context of varying levels of proficiency and varying conditions; (c) identifying and/or assessing student prerequisite competencies of varying types for entry into a program, course, and/or unit; (d) differential sequencing of unit content by way of a deductive via-a-vis inductive mode; (e) differential use of instructional methods, student assignments, and resources reflective of the varying types of learning addressed; (f) formative testing as a diagnostic mechanism employing different types of test items constructed at varying levels of specificity so as to assess different types of learning; (g) prescribing learning correctives of varying types and levels of specificity as tailored to the preferred as well as the deficient learning styles of students; and (h) summative testing as a certification/grading mechanism employing different types of test items constructed at varying levels of specificity so as to assess different types of learning.

With respect to possible dependent variables which already have somewhat of a basis in the current mastery learning literature but could be expanded to assume greater meaning in a comprehensive instructional design context, the following would lend themselves

to investigation: (a) level of learning and variability of learning relative to the initial acquisition, retention, and transfer of intellectual skills, cognitive strategies, and verbal information (see Gagné, 1977; Gagné & Briggs, 1979); (b) level of learning and variability of learning relative to the initial acquisition, retention, and transfer of psychomotor skills; (c) level of learning and variability of learning relative to the initial acquisition , retention, and transfer of subject- and school-related attitudes; (d) academic and general self-concept; (e) school-related anxiety; (f) locus of control; (g) autonomy/independence in learning how to learn; (h) level and variability of time on task; (i) student attendance; (j) course withdrawals; (k) teacher-generated documentation of instructional design efforts at the program syllabus, course syllabus, and instructional unit levels; and (l) teacher satisfaction.

Finally, possible intervening variables which might be appealed to as plausible explanations of relationships between the previously-cited independent and dependent variables could include the following: (a) enhanced cognitive entry characteristics appropriate to each type of learning; (b) enhanced motivation; (c) internal locus of control; (d) enhanced academic and general self-concept; (e) heightened approach tendencies regarding subject areas and schooling; (f) lowered school-related anxiety; (g) appropriate learning style/instructional model match; (h) enhanced instructional cues, learner participation, reinforcement, diagnostic feedback, and corrective prescriptions; (i) enhanced external conditions of learning; (j) principles of subsumption, progressive differentiation, and integrative reconciliation; (k) heightened quality and/or quantity of time on task; and (l) sense of ownership emanating from participative management.

Concluding Remarks

This paper has proposed a comprehensive instructional design model which (a) suggests a systems-based approach to preparing, implementing, and evaluating instruction at the program syllabus, course syllabus, and instructional unit levels; (b) subsumes those various dimensions of a mastery learning strategy which encompass preconditions, operating procedures, and anticipated consequences; (c) relates the generic activities of instructional design to those essential elements comprising a mastery learning strategy; (d) provides a broad-based context for interpreting completed and on-going research and development efforts in mastery learning; and (e) represents a multidimensional framework for guiding future basic and applied research as well as the subsequent development efforts in mastery learning.

Areas of congruence between (a) generic activities in instructional design and (b) essential components in a mastery learning strategy, as well as additional activities mandated by any comprehensive instructional design effort, have provided the basis for identifying possible variables of an independent, moderator, dependent, and intervening nature which might be considered in future mastery learning research and development endeavors.

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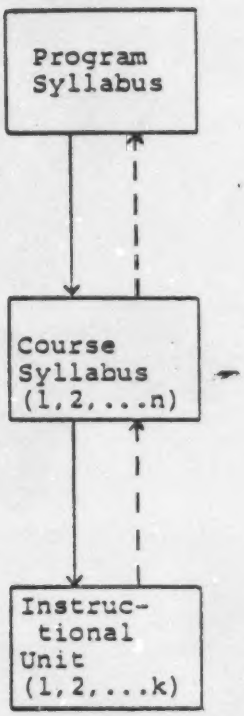

FIGURE 1:
SYSTEMS-BASED MODEL FOR DESIGNING INSTRUCTION

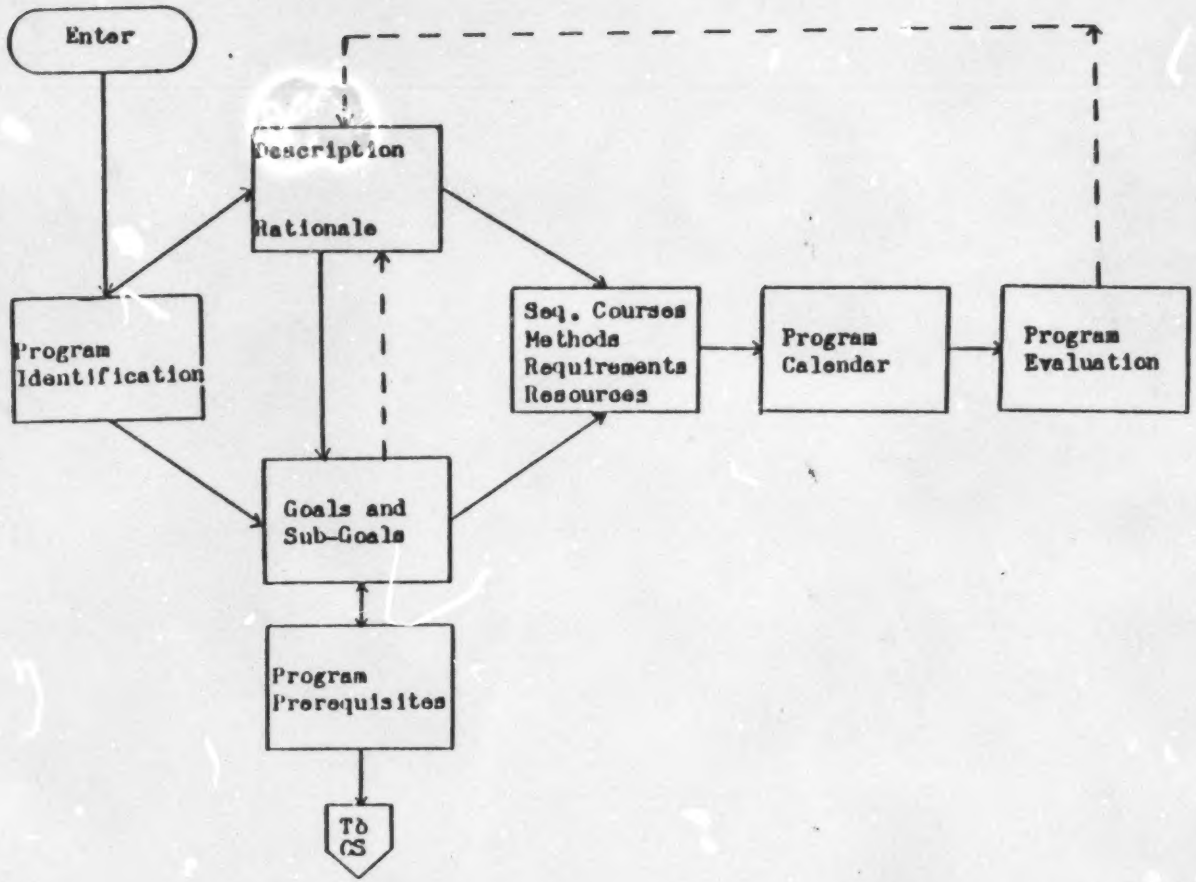

FIGURE 2:
SYSTEMS-BASED MODEL FOR DESIGNING A PROGRAM SYLLABUS

FIGURE 3:
CHECKLIST FOR DESIGNING A PROGRAM SYLLABUS

		Check When Completed
1.	Identify the program by name.	_____
2.	Describe in narrative form the subject-matter content of the program.	_____
3.	State the rationale for the existence of the program.	_____
4.	List the goals and sub-goals of the program.	_____
5.	Determine program prerequisites.	_____
6.	Outline the various courses which comprise the program.	_____
7.	Identify the broad categories of instructional methods employed in the program.	_____
8.	Identify and explain major requirements of the program as well as their corresponding deadlines, if any.	_____
9.	Specify the general types of resources available for the program.	_____
10.	Specify the program calendar with an emphasis on correlating program courses with the appropriate time frames in the program.	_____
11.	Describe the categories of evaluation criteria to be used in the program regarding students and instructors.	_____

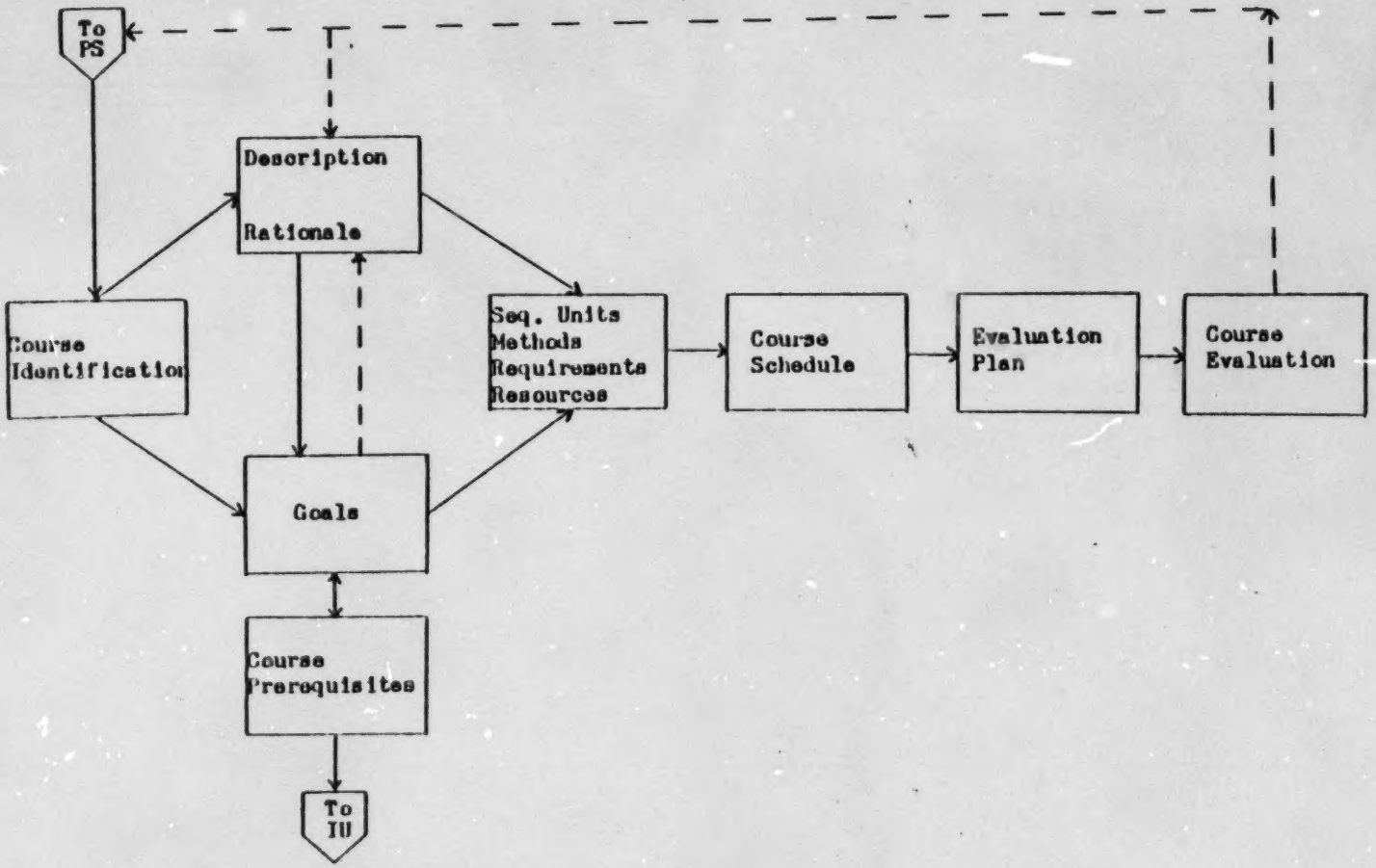

FIGURE 4:
SYSTEMS-BASED MODEL FOR DESIGNING A COURSE SYLLABUS

FIGURE 5:
CHECKLIST FOR DESIGNING A COURSE SYLLABUS

	Check When Completed
1. Specify pertinent identifying information regarding the course (e.g., course title, instructor, time of class meeting, and room location).	_____
2. Describe in narrative form the subject-matter content of the course.	_____
3. State the rationale for the existence of the course.	_____
4. List the goals or general objectives of the course.	_____
5. Determine the prerequisites for the course.	_____
6. Outline the various units which comprise the course.	_____
7. Identify the instructional methods employed in the course.	_____
8. Identify and explain major requirements of the course as well as their corresponding deadlines, if any.	_____
9. Specify the resource materials utilized in the course.	_____
10. Specify the course schedule with an emphasis on correlating items such as dates of class meetings, topics addressed, and assignments.	_____
11. Describe the evaluation plan for the course relative to the following: evaluation approach (e.g., criterion-referenced), numerical range for grades, number and format of summative examinations, value of written assignments, and method of determining final grade.	_____
12. Construct a course evaluation form which would be used to facilitate student feedback relative to the effectiveness of the course.	_____

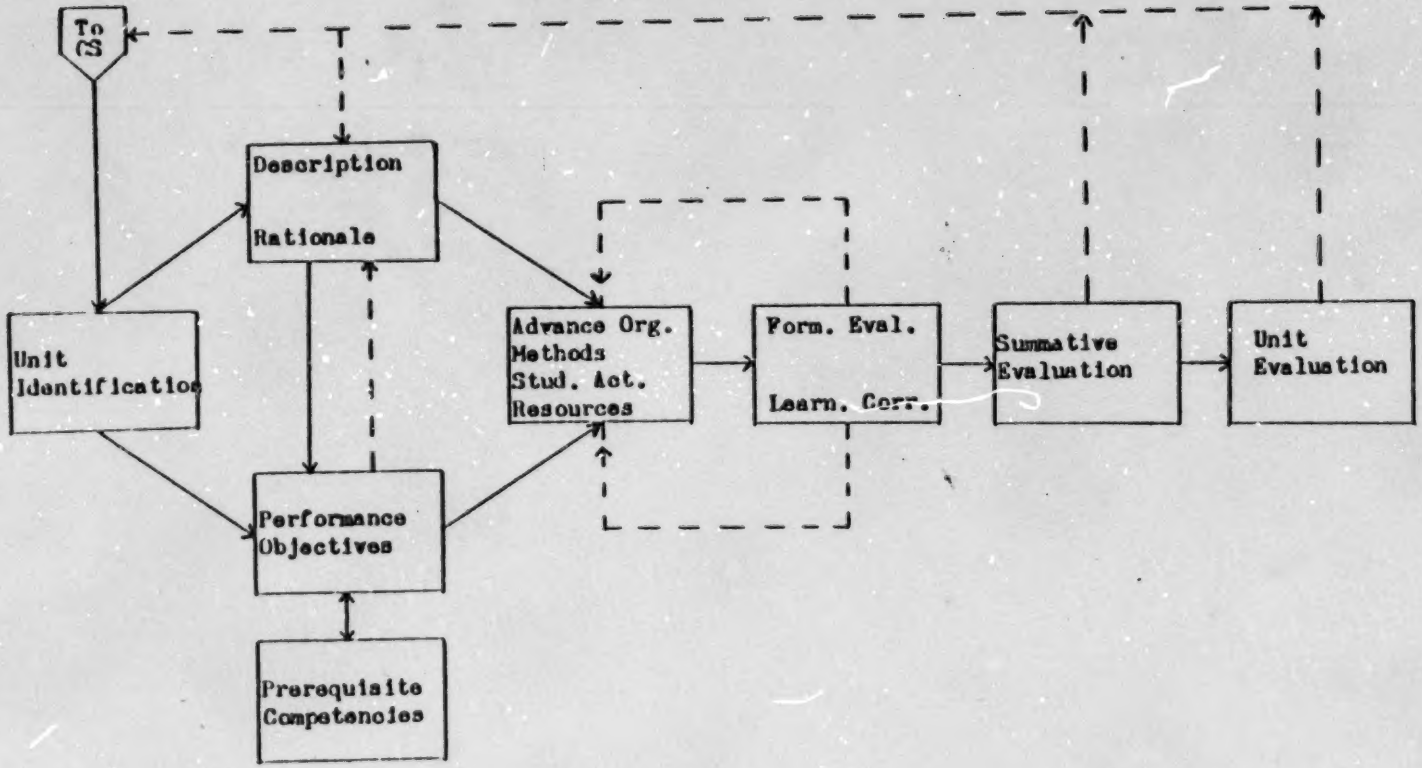

FIGURE 6:
SYSTEMS-BASED MODEL FOR DESIGNING AN INSTRUCTIONAL UNIT

FIGURE 7:
CHECKLIST FOR DESIGNING AN INSTRUCTIONAL UNIT

	Check When Completed
1. Identify the topic addressed in the unit.	_____
2. Describe in narrative form the subject-matter content of the unit.	_____
3. State the rationale for the inclusion and location of the unit in the course.	_____
4. List the performance objectives for the unit.	_____
5. Identify and/or construct a test for prerequisite competencies.	_____
6. Outline in detail (via an advance organizer) the various topics and subtopics which comprise the unit.	_____
7. Identify the instructional methods used in the unit.	_____
8. Identify the various learning activities in which the students will engage as they proceed through the unit.	_____
9. Specify the resources utilized in the unit.	_____
10. Construct a formative test which addresses itself to the performance objectives of the unit and which serves a diagnostic purpose.	_____
11. (a) Identify various activities and assignments of a review and/or remedial nature to which a student would be recycled in order to correct certain learning deficiencies uncovered by the formative test.	_____
(b) Prepare a form which reports the results of the formative test and which establishes a correspondence between items missed on the formative test and learning correctives.	_____
12. Construct a summative test which addresses itself to the performance objectives of the unit.	_____
13. Construct a unit evaluation form which would be used to facilitate student feedback relative to the effectiveness of the instructional unit.	_____